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A Review on Effect of Post Harvest Coatings on Quality and Shelf Life of Guava (*Psidium guajava* L.)

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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Review Article

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Abstract

Because of their fast respiration rate, moisture loss, and microbial susceptibility, guavas (*Psidium guajava* L.) are climacteric, highly nutritious fruits that deteriorate quickly after harvest. Post-harvest coatings have become a popular method for preserving quality and increasing shelf life. Aloe vera (100%) increased shelf life to 9.97 days from 6.43 days in control fruits while maintaining TSS up to 11.41 °Brix. Calcium nitrate (2%) kept ascorbic acid up to 208.75 mg/100 g pulp, decreased PLW to 5.75% (compared to >12–21% in the

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control), and maintained greater firmness (16.42 kg/cm²). While gum acacia (10%) successfully maintained acidity (0.50–0.67%) and minimised weight loss (~5.60%), salicylic acid treatments reduced spoiling to as low as 3.69% compared to 8–18% in untreated fruits. By controlling respiration and gas exchange, coatings regularly postponed ripening, maintaining biological characteristics and lowering the likelihood of degradation. All things considered, post-harvest coatings greatly improve guava's marketability and storage stability, providing a viable and affordable method of lowering post-harvest losses in both ambient and cold storage environments.

Keywords: Post-harvest coatings; Guava (Psidium guajava L.); shelf life, quality parameters; physiological loss in weight (PLW).

1. Introduction

The guava (*Psidium guajava*) is a member of the genus Psidium within the family Myrtaceae. The family Myrtaceae comprises approximately 130 genera and nearly 6,000 recognised species (Vasugi et al., 2023). A significant perennial fruit found in tropical and subtropical regions of the planet is guava. Its primary origins are in tropical America, but because of its hardiness, prolific yield, and high compensation without much care, it progressively became an important crop for trade in a number of other nations. Its substantial nutritional profile contributes significantly to immune enhancement, maintenance of gastrointestinal health, and mitigation of oxidative stress. Widely cultivated across tropical regions, guava serves as an important food resource, contributing to local economic development and providing a source of income for farming communities. Furthermore, its adaptability to diverse growing conditions, relatively low environmental footprint, and suitability for the development of value-added products further highlight its agricultural and economic significance (Sethi et al., 2024, NABCONS, 2022).

India remained the world's leading producer of guava in 2023, with an estimated annual production of 26.3 million metric tonnes. Other major guava-producing countries include Indonesia, China, Pakistan, and Mexico. These countries account for a substantial proportion of global guava production due to favourable climatic conditions, extensive cultivation areas, and well-established agricultural practices (FAO, 2024). Gains in guava production in India are due to a combination of increases in both harvested area and productivity. In 2023-24, the area under guava cultivation was 361,440 hectares where 5368.05 thousand tonnes of guava were produced in India.

Guava fruit is a valuable source of dietary fibre, vitamins A and C, folic acid, and essential minerals such as potassium, copper, and manganese (Hussain et al., 2021). In addition, guava is recognised for its high concentration of antioxidant phytochemicals, including ascorbic acid, carotenoids, antioxidant dietary fibre, and polyphenolic compounds. These bioactive constituents exhibit chemoprotective properties and are reported to possess anti-mutagenic and antiviral activities (Rani and Vijayanchali, 2017).

Guava is classified as a climacteric fruit and is characterised by high moisture content, rendering it highly perishable due to its delicate peel and elevated polyphenol concentration. Consequently, the fruit has a comparatively limited shelf life. Fruits produced during the summer and rainy seasons are particularly susceptible to rapid deterioration, primarily because of increased incidence of pests and diseases, accelerated ripening under conditions of high temperature and humidity, and inferior fruit quality relative to crops harvested during the winter season (Singh, 2011).

The rainy season's conditions also challenge storage and handling, accelerating spoilage, causing a shelf life of only four days at room temperature (Kaur et al., 2019). Guava fruit's significant postharvest restrictions are susceptibility to physical damage, chilling injury, infections, and insect pests. NABCONS (2022) estimates a 16.92% postharvest loss for guava. Guava fruits are difficult to store since they have delicate skin and a short shelf life.

Post-harvest losses can be avoided by increasing shelf life and reducing microbial infection, transpiration, and respiration, as well as membrane disorder (Bisen and Pandey, 2008). Several approaches have been developed to extend the shelf life of guava fruit, among which post-harvest treatment is considered particularly effective. Post-harvest dipping treatments contribute to improved fruit storability by maintaining firmness and inhibiting the growth of spoilage-causing microorganisms (Ahmed et al., 2009). To prevent post-harvest losses, chemical treatment and edible coating are suggested.Recent advancements have highlighted the application of bilayer coatings composed of both chemical and edible materials to form a protective film around fruit surfaces. These coatings reduce the respiration rate and function as a semi-permeable barrier, thereby contributing to improved post-harvest preservation, regulating gas levels, minimizing water loss, retaining fruit quality, preserving texture and color, and increasing market acceptability (Sethi et al., 2024). With an emphasis on their effects on quality features and shelf life, this paper attempts to give a thorough overview of the few post-harvest coatings applied to guava fruits. Recent developments, constraints, and possible future paths in this field of study are also highlighted in the report.

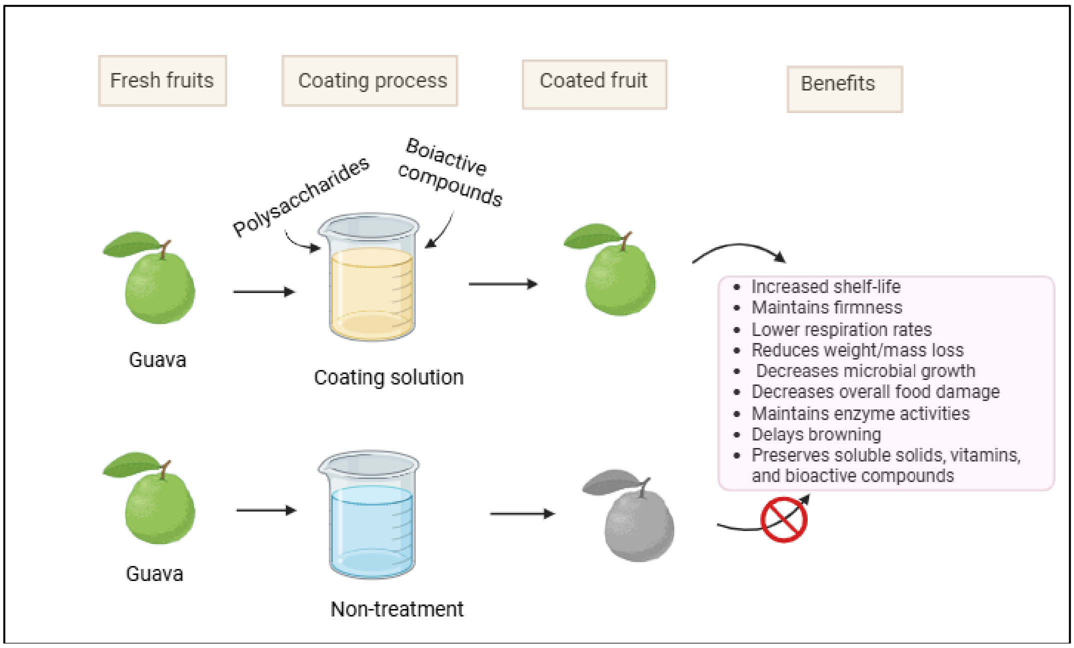

Fig. 1. Benefits of post-harvest coatings
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Post-harvest Coatings for Guava: Post-harvest coatings are an essential tool in extending the shelf life and maintaining the quality of guava fruits, which are prone to rapid deterioration due to their high moisture content and metabolic activity. Various edible coatings, such as chitosan, gum arabic, and aloe vera, have been explored for their effectiveness in preserving guava fruits during storage. These coatings can help reduce weight loss, maintain firmness, and preserve nutritional content, thereby enhancing the overall acceptability of the fruits.

Gum Arabic based coating: Gum Arabic is a pale white to light orange, water-soluble polysaccharide exuded from the Senegal and Seyal species of Acacia trees belonging to the family Fabaceae, subfamily Caesalpinioideae. It is primarily composed of D-galactose, L-arabinose, L-rhamnose, and D-glucuronic acid, along with minor quantities of proteins and metal ions (Tahir et al., 2020). Owing to its favourable properties, including emulsification capacity, water solubility, film-forming ability, and antioxidant activity, Gum Arabic is extensively employed as a natural preservative coating material (Karaaslan et al., 2021). GA glazing has been shown to retain the physical and chemical qualities of several horticultural crops by lowering ethylene production and respiration speed. It decreases physical losses, including weight, hardness, wetness, and decay. This might be due to GA based coatings' reduced gaseous exchange with the external environment and their ability to retain cell integrity. It regulates the amount of total soluble solid constituent (TSS) in certain horticulture crops. GA-based coatings aid in preserving vitamin C during storage and maintain overall acidity. It maintains an appropriate pH level in many fruit and vegetable crops after harvest (Sharma et al., 2023). Research has demonstrated that GA coating, either on its own or in combination with additional preservation agents, can prevent postharvest deterioration and preserve the general quality of harvested climacteric fruits (Alali et al., 2018).

Aloe vera based Coating: Aloe vera is a short-stemmed succulent plant belonging to the family Liliaceae. Aloe vera gel has been widely applied as an edible coating due to its colourless, odourless, and tasteless nature. Furthermore, this natural material represents a safe and environmentally sustainable alternative for post-harvest applications.According to Maan et al., (2018) the polysaccharides in AV gel function as a barrier to moisture and oxygen, causing a slow respiration rate by decreasing CO_2 production and O_2 consumption (Benítez et al., 2013) and preserving the quality of the fruit. Several researchers have studied the effects of AV gel coating on fruits, including nectarines (Ahmed et al., 2009) and sweet cherries (Martínez-Romero et al., 2006). They have found that the AV gel creates a modified atmosphere of internal gases that reduces moisture loss, respiration rate, oxidative browning, softening of tissues, and proliferation of microorganisms.

Calcium based Coating: Calcium is regarded as one of the most critical mineral elements influencing fruit quality (Singh et al., 2019). Calcium ions (Ca^{2+}) interact directly with pectic substances present in the fruit cell wall to form calcium pectate, thereby stabilising the intracellular gel structure, reducing cell wall degradation, and maintaining fruit firmness and texture.

Furthermore, Ca^{2+} can influence the maturity and senescence process of fruits by its interaction with calmodulin (CaM), thus altering the secondary metabolism inside postharvest fruits, such as respiration, cell wall loosening and antioxidant system (Zhang et al., 2024). Studies reveal that post-harvest treatment of various calcium compounds has enhanced the shelf life, reducing the spoilage. The finding that calcium salts interfere with ethylene's link to its binding site represents a powerful tool for postharvest management of climacteric fruits (Kumar et al., 2012).

Salicylic acid based Coating: Salicylic acid (SA), also known as 2-hydroxybenzoic acid or $C_7H_6O_3$, is a basic phenolic molecule that is widely distributed in plants and is involved in numerous processes related to plant growth and development as well as the regulation of stress responses (Asghari and Aghdam, 2010). This stress hormone induces resistance enzymes, delays pericarp browning, reduces stress lignification, and improves chilling tolerance in fruits (Madhav et al., 2021). Postharvest application of salicylic acid has been reported to influence the physicochemical properties of fruits and vegetables, particularly by modulating physiologically active constituents (Supapvanich and Promyou, 2013). Previous studies have demonstrated that salicylic acid suppresses the activity of ACC oxidase, thereby inhibiting the conversion of ACC to ethylene (Singh et al., 2019). Furthermore, postharvest treatment with salicylic acid has been found to be effective in preserving fruit quality and prolonging the shelf life of guava fruits (Singh et al., 2017).

2. Literature Search Methodology

In order to guarantee thorough coverage of published research on post-harvest coatings in guava (*Psidium guajava* L.), this study was carried out using a structured literature search approach. To find pertinent peer-reviewed publications, scientific databases such as Scopus, Web of Science, ScienceDirect, PubMed, and Google Scholar were methodically searched. Combinations of keywords and Boolean operators were used in the search, such as "guava" AND "post-harvest coating," "edible coating" AND "*Psidium guajava*," "gum acacia," "aloe vera gel," "chitosan," "calcium nitrate," "salicylic acid," "shelf life," "physiological loss in weight," "total soluble solids," "titratable acidity," "ascorbic acid," "firmness," and "decay loss."

In order to encompass both foundational research and contemporary developments in coating technologies, studies published between 2000 and 2025 were mostly taken into consideration. Peer-reviewed research publications, investigations on post-harvest treatments applied to guava fruits, and the availability of quantitative data pertaining to physicochemical, biochemical, and storage parameters were among the inclusion criteria. Non-peer-reviewed papers, duplicate records, review articles without original data, and research with unclear methodological details were among the exclusion criteria. In order to compile information about the impacts of various coating materials on guava quality parameters and shelf life under ambient and cold storage conditions, the chosen items were critically assessed and compared.

2.1 Impact of Coatings on Quality and Shelf Life

Total soluble solids (TSS ^{0}Brix): Several studies have looked at how post-harvest coatings affect the total soluble solids (TSS) content of guava in different storage conditions. Coating guava cv. Gola with 20%, 40%, 60%, and 80% aloe vera gel led to a gradual increase in TSS, especially with the 60% and 80% concentrations, throughout the storage period, suggesting that the treatments effectively slowed down the respiration rate of guava fruits during storage (Rehman et al., 2020). A 100% concentration of aloe vera gel kept the TSS value highest (11.41 ºBrix) in guava cv. Lucknow-49 by the tenth day of storage (Sharanaiahswamy et al., 2022). In contrast, guava fruits treated with aloe vera gel combined with *Acalypha indica* leaf extract recorded the lowest TSS values among all treatments (Refilda et al., 2022). Generally, TSS levels increase as fruits ripen and are stored longer, with the rise being more noticeable in fast-respiring fruits. In guava cv. Shewta, fruits coated with 10% gum acacia had the lowest TSS (14.56 ºBrix) at the end of storage, while untreated fruits had the highest TSS (16.2 ºBrix), indicating that gum acacia might slow down ripening (Gurjar et al., 2018). Surahi guava coated with gum arabic also had the lowest TSS content on the fifteenth day of storage compared to other treatments, a result linked to delayed senescence and slower sugar accumulation in coated fruits (Zaidi et al., 2023). By the 20th day of storage, guava fruits coated with 3% gum acacia and tulsi leaf extract showed the highest TSS, while the control group had the lowest, highlighting the combined effect of the biopolymer and plant extract (Sreelakshmi et al., 2024). In rainy season guava, the control group recorded the lowest TSS (5.16 ºBrix) ten days after treatment, while fruits treated with 10% gum acacia had the highest TSS (5.95 ºBrix), similar to the 20% gum acacia. In winter storage, the highest TSS of 11.26 ºBrix was noted on the 12th day in fruits treated with 10% gum acacia (Dutta et al., 2017).

The effects of chemical coatings have also been studied. A significant increase in TSS of guava was observed when fruits were immersed in chitosan and salicylic acid (2 mM) during a 15-day shelf-life period (Lo'Ay and Taher, 2018). On the 12th day of storage, the combination of salicylic acid (SA) at 1000 µmol and ascorbic acid (AA) at 500 µmol produced the highest TSS in guava cv. Allahabad Safeda, while SA at 500 µmol and AA at 250 µmol were statistically simila (Kapoor et al., 2024). Similarly, guava fruits treated with 140 ppm salicylic acid showed a TSS of 11.68 ºBrix, slightly higher than the control (11.58 ºBrix) (Tabasum et al., 2019). Calcium nitrate has also proven effective in maintaining or improving TSS levels. Both pre-harvest spray and post-harvest dip of 2% calcium nitrate kept the TSS highest in guava cv. Gwalior-27 (Rajput et al., 2008). A mix of 2% calcium nitrate and 0.1% carbendazim gave the highest TSS (10.77 ºBrix) in guava cv. Allahabad Safeda at the end of storage (Gangle et al., 2019). Treatment with 1.0% calcium nitrate maintained the highest TSS (13.06 ºBrix), while the control had the lowest (11.23 ºBrix). Fruits treated with 1.5% calcium nitrate also sustained higher TSS levels during storage (Bhooriya et al., 2018). A similar trend was reported in kinnow fruit quality, where 10% gum arabic resulted in the lowest TSS (11.01 ºBrix), followed by 5% gum arabic (11.05 ºBrix), while control fruits showed the highest (11.3 ºBrix), suggesting that gum arabic effectively moderated sugar accumulation by slowing respiration and ripening (Ahlawat et al., 2018).

Titrable acidity % and pH: Titratable acidity in guava fruits usually decreases during storage because organic acids are used in respiration and metabolic processes. However, the degree of this reduction varies significantly depending on the post-harvest treatments applied. Among the edible coatings tested on guava cv. Lucknow-49, including aloe vera gel, sodium alginate, and guar gum in different amounts, 100% aloe vera gel maintained the lowest acidity level (0.55%) by the tenth day of storage (Sharanaiahswamy et al., 2022). In guava cv. Gwalior-27, the highest titratable acidity (0.47%) was recorded in the control group, while fruits treated with a 2% calcium nitrate dip showed the lowest acidity (0.31%) by the ninth day, highlighting the effectiveness of calcium-based treatments (Rajput et al., 2008). In guava fruits of cv. Surahi treated with gum acacia, aloe vera, ginger extract and garlic extract, those coated with gum acacia consistently maintained a lower juice pH, indicating higher acidity, from the third to the fifteenth day of storage (Zaidi et al., 2023). Similarly, 1% calcium nitrate treatment resulted in the highest acidity value (0.64%) during storage, while the control group (distilled water dip) had the lowest acidity (0.42%) (Bhooriya et al., 2018). Similarly, a steady decline in acidity was noted across all treatments, but guava fruits treated with 2% calcium nitrate and 0.1% carbendazim maintained the highest acidity (0.67%) compared to 0.43% in control fruits by the twelfth day of storage (Gangle et al., 2019).

Guava fruits coated with gum acacia (GA) alone or with moringa extract also showed higher acidity, with GA 10% and GA 10% + moringa 10% recording the highest values (El-Gioushy et al., 2022). In cv. Allahabad Safeda, applying salicylic acid (1000 µmol) and ascorbic acid (500 ppm) post-harvest resulted in the highest titratable acidity (0.41%), while the control recorded the lowest (0.23%) (Kapoor et al., 2024). A combined treatment of 2 mM chitosan and salicylic acid also consistently retained higher acidity throughout the shelf life, unlike the control, which experienced a sharp drop in titratable acidity at all stages of fruit development (Lo'Ay and Taher, 2018). Coating guava fruits with high amounts of aloe vera (1700 mL) and *Acalypha indica* (200 mL) maintained significantly higher titratable acidity (1.90%) after 15 days of storage compared to those treated with distilled water (0.40%) (Refilda et al., 2022). In guava cv. Shweta, the titratable acidity on the ninth day of storage was 0.82% in uncoated fruits, while fruits coated with 10% gum acacia showed a reduced value of 0.50%, suggesting that the coating effectively reduces acid loss (Gurjar et al., 2018).

Total sugar (%): Total sugar content in guava fruits is an important indicator of ripening and sweetness, and it is often influenced by post-harvest treatments that can regulate the conversion of starch into sugars. The total sugar content generally increased during storage, but guava fruits treated with 80% aloe vera gel showed a more consistent sugar level, as the coating slowed down starch conversion (Rehman et al., 2020). The control treatment showed the highest rate of increase in total sugar content, whereas guava fruits treated with 25% aloe vera gel combined with 1% chitosan recorded a significantly lower rate of increase. Specifically, untreated Thai Piara guava reached the highest total sugar content (9.79%) after 10 days of storage, while Swarupkathi Piara treated with the aloe vera and chitosan combination recorded the lowest (5.78%) (Supa et al., 2024). In guava cv. L-49, the highest total sugar content (8.42%) on the 10th day of storage was observed in fruits coated with 100% aloe vera gel, while 60% aloe vera gel showed the lowest value (6.04%), suggesting that higher concentrations may support more efficient sugar accumulation (Sharanaiahswamy et al., 2022). In rainy season guava, total sugar content was highest (3.93%) on the 10th day after treatment with 10% gum acacia, closely followed by 20% gum acacia (3.89%), while the control recorded the lowest (3.13%). During the winter season, 20% gum acacia produced the highest total sugar content (6.66%) on the 12th day of storage (Dutta et al., 2017).

Salicylic acid treatments also influenced sugar accumulation. Guava fruits treated with 140 ppm salicylic acid had the highest total sugars (6.75%), which was statistically similar to the 70 ppm treatment (6.63%), while the control group showed the lowest sugar content (Tabasum et al., 2019). Fruits treated with 1% calcium nitrate maintained the highest total sugar content (7.09%) by the end of storage, while the control fruits showed lower levels (Bhooriya et al., 2018). Similarly, in guava cv. Allahabad Safeda, treatment with 2% calcium nitrate and 0.1% carbendazim maintained the highest total sugar content (7.23%) compared to 5.71% in the control group on the 12th day of storage (Gangle et al., 2019)). These results suggest that post-harvest treatments such as aloe vera gel, gum acacia, salicylic acid, and calcium nitrate can regulate sugar accumulation in guava by moderating starch breakdown and delaying ripening, thereby improving fruit quality during storage.

Ascorbic acid (mg/100g pulp): Ascorbic acid content is an important nutritional quality factor in guava, and several studies have shown how post-harvest treatments can help maintain or even enhance its levels during storage. In guava cv. Allahabad Safeda, fruits treated with 2% calcium nitrate recorded the highest ascorbic acid content (208.75 mg/100 ml), followed by those treated with 1% calcium nitrate, while the control group had the lowest mean value (136.69 mg/100 ml) (Kaur et al., 2019). Similarly, fruits treated with 1% calcium nitrate showed the maximum ascorbic acid content (165.33 mg/100 g) at the end of the storage period, compared to the minimum value (113.33 mg/100 g) in the control (Bhooriya et al., 2018). A combination of 2% calcium nitrate and 0.1% carbendazim produced the highest concentration (176.00 mg/100 g), with the control group showing the lowest (101.33 mg/100 g) in guava cv. Allahabad Safeda (Gangle et al., 2019). Supporting these findings, pre-harvest spray and post-harvest dip with 2% calcium nitrate also maintained the highest ascorbic acid content up to the ninth day of storage (Rajput et al., 2008). Edible coatings have likewise proven effective in preserving vitamin C. In guava cv. Shweta, fruits coated with 10% gum acacia maintained the highest ascorbic acid content (243 ± 3.27 mg/g), compared to the lowest value in the control (230 ± 2.21 mg/g) (Gurjar et al., 2018). During the rainy season, guava fruits treated with 10% gum acacia recorded a maximum of 150.1 mg/100 g pulp ten days after application, while the control showed the lowest (133.28 mg/100 g). In winter, the highest ascorbic acid content (232.15 mg/100 g) was obtained with a 20% gum acacia treatment, while the control retained only 210.31 mg/100 g (Dutta et al., 2017). Other combinations, such as gum acacia (10%) with moringa (10%), further improved retention, confirming that coated fruits preserved more vitamin C than untreated ones (El-Gioushy et al., 2022).

Salicylic acid applications also demonstrated strong potential in maintaining ascorbic acid levels. On the 12th day of storage, guava cv. Allahabad Safeda fruits treated with 1000 μmol salicylic acid showed the highest ascorbic acid content (224.92 mg/100 g pulp), while untreated fruits recorded the lowest value (147.87 mg/100 g pulp) (Kapoor et al., 2024). A coating of chitosan with 2 mM salicylic acid effectively preserved the ascorbic acid content of guava cv. Banati across all maturity stages during shelf life (Lo'Ay and Taher, 2018). Salicylic acid-coated fruits also consistently retained higher ascorbic acid levels compared to uncoated ones (Gurjar et al., 2018). Aloe vera gel treatments further helped maintain vitamin C content. In guava cv. Gola, aloe vera gel-coated fruits preserved ascorbic acid effectively throughout the storage period, while the control group showed a significant decline (Rehman et al., 2020). Overall, these findings indicate that post-harvest treatments using calcium nitrate, gum acacia, salicylic acid, chitosan, and aloe vera gel are highly effective in preserving ascorbic acid content, thereby enhancing the nutritional and storage quality of guava fruits.

Firmness (kg/cm^2): Fruit firmness is an important quality that impacts the texture and consumer acceptance of guava during storage. In guava cv. Allahabad Safeda, fruits treated with 2% calcium nitrate retained the highest firmness (16.42 kg/cm²), while the control fruits recorded the lowest firmness (14.14 kg/cm²) (Kaur et al., 2019). In the Sardar variety, 2% calcium nitrate was also found to be the best treatment for maintaining firmness during storage. Studies on guava cv. Lalit revealed that fruits coated with 10% gum arabic had much higher firmness (8.12 ± 1.67 kg/cm²) at the end of storage compared to control fruits, which showed the lowest value (3.33 ± 1.08 kg/cm²) (Lo'Ay and Taher, 2018). Across different maturity stages, guava cv. Banati fruits coated with 2 mM salicylic acid retained better firmness throughout their shelf life than uncoated fruits and other coated treatments (Gurjar et al., 2018). Higher firmness values were also recorded in fruits coated with gum acacia (10%) alone or in combination with moringa extract (10%) compared to other treatments (El-Gioushy et al., 2022). In guava cv. Lucknow-49, fruits treated with 100% aloe vera gel had the highest firmness (1.26 kg/cm²) on the tenth day of storage, followed by 60% aloe vera gel (1.24 kg/cm²), while the control group showed the lowest firmness (Sharanaiahswamy et al., 2022). These findings suggest that post-harvest techniques such as calcium nitrate, salicylic acid, aloe vera gel, and gum-based coatings are effective in preserving fruit firmness during storage, thereby helping maintain the texture and shelf life of guava.

Table 1. Effect of post-harvest coatings on guava

Coatings	Findings	References
Aloe vera	-Aloe vera gel modified with virgin coconut oil (VCO) reduced weight loss. -Maintained firmness and delayed ripening. -Helped preserve guava quality during storage.	(Gustira et al., 2024)
Aloe vera	-Aloe vera coating retained firmness and color. -Maintained TSS and acidity levels. -Prolonged shelf life under refrigeration.	(Dutta Roy et al., 2023)
Gum acacia	- Edible coating formulated from *Albizia lebbeck* gum significantly delayed softening of guava fruits during storage. - Maintained higher firmness, reduced weight loss, and preserved titratable acidity and ascorbic acid content. - Effectively slowed down physiological and biochemical degradation processes.	(Gull et al., 2024)
Gum acacia	- A composite coating of gum arabic, beeswax, and coconut oil preserved postharvest guava quality under both ambient and chilling conditions. - Reduced respiration rate, maintained higher TSS and lower decay incidence. - Prolonged shelf life by modulating gas exchange and moisture loss.	(Ting et al., 2025)
Calcium nitrate	- Application of calcium citrate significantly improved firmness and reduced decay incidence in winter guava during ambient storage. - Maintained higher titratable acidity and total soluble solids (TSS), contributing to delayed senescence and extended shelf life.	(El-Bana and Ennab, 2023)
Calcium nitrate	- Post-harvest dipping of guava cv. Sardar in calcium chloride (1% and 2%) and calcium nitrate (1% and 2%) effectively delayed ripening and retained firmness. - Calcium nitrate 2% treatment showed the best results in reducing weight loss, maintaining TSS, and enhancing overall storage quality.	(Hinge, 2022)
Salicylic acid	- Post-harvest application of salicylic acid (SA) alone or combined with ascorbic acid (AA) significantly delayed ripening and reduced physiological weight loss in guava cv. Allahabad Safeda. - SA + AA treatment maintained higher ascorbic acid content, firmness, and total soluble solids (TSS), effectively extending storage life under ambient conditions.	(Kapoor et al., 2025)
Salicylic acid	Allahabad Safeda fruits treated with 140 ppm salicylic acid had a PLW of 1.79%, which was similar to the 70-ppm salicylic acid treatment at 1.88%, while the control had the highest PLW of 2.48%	(Tabasum et al., 2019)

Physiological loss in weight (%): Physiological loss in weight (PLW) is an important sign of post-harvest spoilage in fruits, and several studies have shown that different treatments can help reduce this loss in guava.

Treating guava cv. Allahabad Safeda with 2% calcium nitrate led to the lowest PLW of 5.75% on the ninth day of storage, followed closely by a 6.01% loss with 1% calcium nitrate (Kaur et al., 2019). 1% calcium nitrate dip lasting 4 minutes significantly decreased weight loss, while the control group using distilled water had the highest PLW (Bhooriya et al., 2018). A reduced PLW of 12.05% was noted in guava cv. Allahabad Safeda treated with 2% calcium nitrate and 0.1% carbendazim, compared to a 21.04% loss in the control group (Gangle et al., 2019). Aloe vera gel at 80% minimized weight loss to 3.93% by the 12^{th} day of storage (Rehman et al., 2020). Guava cv. Lucknow-49 coated with 100% aloe vera gel had the least physiological weight loss on the 10th day of storage (Sharanaiahswamy et al., 2022). A mix of 85% aloe vera and 10% *Acalypha indica* extract resulted in the lowest weight loss of 11.19%, while the control group faced a significant loss of 30.48% (Refilda et al., 2022). Guava cv. Allahabad Safeda fruits treated with 140 ppm salicylic acid had a PLW of 1.79%, which was similar to the 70-ppm salicylic acid treatment at 1.88%, while the control had the highest PLW of 2.48% (Tabasum et al., 2019). Edible coatings made from gums have also shown good results in reducing PLW. A 10% gum acacia treatment led to the lowest weight loss of 5.60% on the 12th day, which was close to the 5.62% loss with 20% gum acacia (Dutta et al., 2017). Guava cv. Lalit coated with 10% gum acacia had a significantly lower weight loss of 15.46 ± 1.95% after 9 days, while the control fruits had a higher loss of 19.95 ± 2.35% (Gurjar et al., 2018). Guava fruits treated with 10% gum acacia also showed significantly reduced PLW across different seasons (El-Gioushy et al., 2022). Combining gum acacia with 6% guava leaf extract effectively reduced weight loss by the end of the storage period (Sreelakshmi et al., 2024). The use of synthetic and bi-layer coatings has also proven effective. A bi-layer coating of 5-sulfosalicylic acid (2 mM) and vegetable wax (1:4 v/v) significantly reduced weight loss in cv. Allahabad Safeda and Lalit stored at 5°C, with losses 43% and 35% lower than the control, respectively (Madhav et al., 2021). Although primarily focused on aonla, using 1% calcium nitrate with gibberellic acid resulted in a lower PLW of 11.84% compared to the control, which was at 13.61% (Singh et al., 2015). Similar results were reported in kinnow, where fruits coated with 10% gum arabic had the lowest PLW of 6.36% on the 49th day of storage, with those treated with 5% gum arabic showing a 6.77% loss (Ahlawat et al., 2018). These findings clearly show that post-harvest treatments involving calcium nitrate, aloe vera gel, salicylic acid, gum acacia, and bi-layer coatings can significantly reduce physiological weight loss in guava, thereby improving its marketability and shelf life.

Decay/Spoilage loss (%): Several studies have shown that different post-harvest treatments can effectively reduce spoilage and decay in guava fruits. Guava cv. Allahabad Safeda fruits treated with 200 ppm of salicylic acid had the lowest spoilage rate at 7.25%, whereas the untreated control group had the highest spoilage rate at 18.10% (Kaur et al., 2019). Salicylic acid at 140 ppm was found to be the most effective in reducing rotting to 3.69% under normal conditions, compared to 8.09% in the control group (Tabasum et al., 2019). A combination of aloe vera (1700 ml) and Acalypha indica (200 ml) effectively prevented fruit deterioration for up to 15 days, with a decay percentage of only 3.33%, while the control group showed a significantly higher decay rate of 14.44% (Refilda et al., 2022). In guava cv. Gwalior-27, the control group recorded the highest rotting percentage, while the lowest rotting rate of 13.93% occurred in fruits that received both a pre-harvest spray and a post-harvest dip with 2% calcium nitrate (Rajput et al., 2008). Among different biopolymer coatings, a 100% aloe vera gel application resulted in the lowest decay percentage on the tenth day of storage for guava cv. Lucknow-49 (Sharanaiahswamy et al., 2022). Similarly, coating guava fruits with 10% gum acacia and 10% moringa extract produced the lowest decay values across treatments (El-Gioushy et al., 2022). Post-harvest treatment with 2% calcium nitrate and 0.1% carbendazim in guava cv. Allahabad Safeda also resulted in the lowest percentages of damaged fruits at 8.33% on the 9th day and 16.66% on the 12^{th} day of storage, compared to other treatments (Gangle et al., 2019). These findings suggest that using salicylic acid, aloe vera gel, calcium nitrate, and natural extracts like moringa and Acalypha indica can significantly reduce decay and help maintain the quality of guava after harvest.

Shelf life (days): Several studies have shown the effectiveness of edible coatings and other post-harvest treatments in extending the shelf life of guava. Coated guava fruits can be stored for 6 to 11.67 days, with those treated with 25% aloe vera gel and 1% chitosan showing the longest shelf life of 11.67 days; Thai Piara guava treated with the same combination also showed an extended shelf life of up to 13.00 days (Supa et al., 2024). The guava cultivars Allahabad Safeda and Lalit, when coated with a bilayer of vegetable wax (1:4 v/v) and salicylic acid (2 mM) and stored at 5°C, maintained a hue angle close to 100° (yellowish green) for 12±2 days without any chilling injury (Madhav et al., 2021). In guava cv. Lucknow-49, fruits treated with 100% aloe vera gel had the longest shelf life at 9.97 days, those treated with 80% aloe vera gel lasted 9.58 days, while the untreated control fruits had the shortest shelf life at 6.43 days (Sharanaiahswamy et al., 2022). Guava fruits treated with 1% calcium nitrate could be stored for up to 12 days, compared to 9 days in the control group

(Bhooriya et al., 2018). Application of salicylic acid (100, 200, and 300 ppm) and ascorbic acid (1.0, 1.5, and 2.0%) helped preserve fruit quality in both ambient and cold storage conditions; notably, after two weeks of cold storage, salicylic acid at 300 ppm led to a fruit spoilage rate of only 2.03%, compared to 16.50% in the control (Kaur et al., 2019). Guava fruits coated with gum acacia (10%) and gum acacia combined with moringa extract (10%) showed longer shelf life over two seasons (El-Gioushy et al., 2022). The highest shelf life of guava cv.

Gwalior-27 was achieved with a combination of pre-harvest spray and post-harvest dip using 2% calcium nitrate, resulting in a shelf life of 10.17 days (Rajput et al., 2008). These findings suggest that various edible coatings and mineral treatments, including aloe vera gel, chitosan, salicylic acid, calcium nitrate, and gum acacia, can significantly improve the shelf life and maintain the post-harvest quality of guava fruits under different storage conditions.

3. Conclusion

Guava (*Psidium guajava* L.) is a nutritious but highly perishable tropical fruit that has significant economic value. Post-harvest spoilage of guava, especially during the rainy season and under normal conditions, is a major problem that affects its marketability and profitability. Using post-harvest coatings has become an effective method to keep fruit fresh longer. These coatings create a semipermeable barrier that controls gas exchange, reduces microbial activity, and cuts down on physiological losses. This review shows that edible coatings like gum acacia, aloe vera gel, and chitosan, as well as chemical treatments such as calcium salts and salicylic acid-based solutions, have been successful in reducing weight loss, delaying ripening, improving fruit firmness, and maintaining important quality factors like total soluble solids, titratable acidity, total sugars, and ascorbic acid content. Gum acacia and calcium nitrate have proven to be effective treatments for improving the postharvest quality and shelf life of guava in both normal and cold storage settings. Overall, using the right post-harvest coatings provides a sustainable, cost-effective, and consumer-friendly way to cut postharvest losses and boost the market value of guava fruits.

4. Study Limitations

This review is restricted by its dependence on previously published research with different experimental designs, storage circumstances, coating concentrations, and guava cultivars, despite providing a thorough summary of the impact of post-harvest coatings on quantitative quality measures of guava. Direct comparison and meta-analysis are difficult due to the heterogeneity of the research. Furthermore, judgements about large-scale commercial applicability are limited because the majority of studies were carried out at laboratory or small-scale levels. Coating performance may also be impacted by regional customs and climate variations, which may not be adequately represented in the reviewed literature. Lastly, there is a need for more standardised and field-based research since economic viability, consumer sensory acceptance, and long-term safety evaluations of specific coating formulas are still understudied.

Disclaimer (Artificial Intelligence)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of this manuscript.

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Competing Interests

Authors have declared that no competing interests exist.

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